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ABSTRACT

Two assumptions commonly held in educational psychology are questioned. According to the first assumption, mental states and processes are studied in isolation. According to the second assumption, an individuals' psychology, that which is of relevance to education, is often studied out of social and cultural context, rendering suspect explanations that focus solely on the individual learner. These assumptions continue to underlie much of the empirical work in educational psychology, despite increasing interest in socio-cultural, constructivist, and contextual perspectives and theories. Based on a perception of the individual as having an undivided psychology, and as being an integrative part of a wider context, a different conception of educational psychology is presented. A triad of missions for the field is proposed: (1) develop empirically-grounded explanations; (2) provide practial guidance; and (3) design educational settings. This conception leads to an educational psychology the hallmark of which is the study and design of complex composites (learning environments), rather than discrete variables, to complement the study of their separate contributing components (e.g., intelligence, motivation, schemata). A set of tools is presented to show that methodological tools do exist for the study of whole individuals within the wider context of a composite learning environment. Contains 62 references. (JBJ/Author)

# Unorthodox Thoughts on the Nature and Mission of Contemporary Educational Psychology

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# Unorthodox Thoughts on the Nature and Mission of Contemporary Educational Psychology


## Abstract

Two assumptions commonly held in educational psychology are questioned. According to the first assumption, mental states and processes are studied in isolation, in what Bartlett has called "simplification by isolation". According to the second assumption, individuals' psychology, that which is of relevance to education, is often studied out of social and cultural context, rendering suspect explanations that focus solely on the individual learner. These assumptions continue to underly much of the empirical work in educational psychology, despite increasing interest in socio-cultural, constructivist, and contextual perspectives and theories. Based on a perception of the individual as having an undivided psychology, and as being an integrative part of a wider context, a different conception of educational psychology is presented. A triad of missions for the field is proposed - to develop empirically-grounded explanations, provide practical guidance, but particularly to design educational settings. This conception, in turn, leads to an educational psychology the hallmark of which is the study and design of complex composites (learning environments), rather than discrete variables, to complement (not replace!) the study of their separate contributing components (e.g., intelligence, motivation, schemata). This makes educational psychology analogous to such fields as architecture and aerospace science, fields that deal with composites and whose units of analysis reflect rather than reduce the complexity of the phenomena they study and design. A set of tools (Small Space Analysis, a case of MDS) is presented to show that methodological tools do exist for the study of whole individuals within the wider context of a composite learning environment.

Exciting and important challenges currently face the social sciences and psychology: from a war of paradigms to the call for greater ecological validity of research, from critiques of that most cherished of methods -- the experiment, to demands for more real-life research, and from cries for the adoption of narrative approaches to the questioning of long standing criteria of "objectivism". Where in all this is the field of educational psychology? With all the changes surrounding psychology and challenging it, what should educational psychology be about nowadays? Is it to continue revolving around the same issues -- evaluation and measurement, motivation, intelligence, school learning, and cognition -- which were its main staple more than ten years ago (Ball, 1984)? Should educational psychology change with the times and with the changes of paradigms, concerns, and assumptions? If so, what should it attempt to achieve and what should its new mission be now that it enters its second century?

The purpose of this paper is to present a few unorthodox thoughts about the nature and the mission of contemporary educational psychology. A few of these thoughts emanate from reflections on the prevailing empirical work in educational psychology and its contribution to education; more of this unorthodoxy comes from my four years as the editor of Educational Psychologist, and still some more from the novel, pioneering works of those educational psychologists (e.g., A. L. Brown, 1992)who have come to realize and exemplify the thoughts I wish to present here.

Specifically, the first purpose of this paper is to critically examine two of the framing assumptions that have traditionally underlied and guided mainstream educational psychology. It will be argued that these assumptions are not as valid today as educational psychologists used to regard them in the past. This, then leads me to argue that the sights of educational psychology ought to be raised from the level of the isolated individual and isolated variable to the level of the composite. The second, and closely related purpose is to offer a re-formulation of the field's main (but certainly not exclusive) mission. This, it will be argued, is to explain, guide but particularly design. In this triad, design occupies a central place subsuming both the explanation and the guidance roles, thus serving both the development of theory and the improvement of practice. This conception

of educational psychology places the field on a par with such fields as architecture and aerospace science, fields that deal with composites and whose units of analysis reflect rather than reduce the complexity of the phenomena they study and design.

## Tension Between Orientations

Educational psychology, for much of its history, was characterized by the tension between rigorous, disciplinary scholarship that serves science, and field-oriented work that serves practice (e.g., Berliner, 1992; Mayer, 1992; Pintrich, 1994; Resnick, 1981; Shulman, 1981; Wittrock, 1992). This tension yields a gap between the orientation of an indifferent observer of (allegedly) natural phenomena, an observer who practices the analytic methods of a semi-natural science, and the orientation needed for the study and practical improvement of the complex and artifactual field of education. To close that gap between scientifically sanctioned analytic rigor and practical holism (and closing the gap we better achieve), certain changes of assumption, scholarly orientation, and practice need to take place. As pointed out by McGuire (1973), a while ago, once the field ceases to study decontextualized individuals who are chopped up into isolated psychological components, raising its sights to the level of real-life composites, its science- and practice-oriented questions and hypotheses will merge. This, though, is not where the majority of empirical work in educational psychology is today, despite the fact that the field has "returned to school" and to the learning of real subject matter.

There are, of course a few pioneering exceptions whose assumptions and scholarly practices deviate from the traditionally held ones, and whose main strategy of scholarship is <u>design</u> (e.g., A. L. Brown, 1992; Cognition and Technology Group at Vanderbilt, in press; Kass, Burke, Blevis, & Williamson, 1993/4; Salomon & Perkins, in press). These exceptions, and they <u>are</u> exceptions, signify the direction that the field of educational psychology should in my opinion start taking, as they exemplify a desired integration of scientific theory development with the badly needed improvement of practice and sound research. Despite a growing interest in the social and cultural contexts of learning (e.g., e.g., Lave & Wegner, 1991), in the distribution of cognitions (Salomon, 1993), in the design of complex learning environments (e.g., Scardamalia & Bereiter,

1993), and in the Vygotskian perspective (e.g., Cole, 1991), educational psychological research, by and large, is not doing that as yet. To do it one would need to begin with an examination of some of the field's prevailing assumptions. To such an examination I turn next.

## Prevailing Underlying Assumptions

Two underlying assumptions seem to have dominated educational psychology since its early days. These assumption continue to underly much of the empirical work in the field. One assumption pertains to the "grain size" of human psychology, often leading to the isolation-by-reduction of mental states and processes. Thus, it is often assumed that because individuals operate by means of their cognitions, emotions, desires, and abilities, because each of these is a complex world onto itself, and because it is epistemologically recommended that complex phenomena be broken down into simpler and controllable components (Banaji & Crowder, 1989), these phenomena are commonly studied as separate entities. Hence compartmentalization of the individual's psychology has come to characterize the field of psychology in general and that of educational psychology in particular. The second assumption pertains to the wider context in which educationally-relevant human psychology is very often studied; the locus of much interesting and important psychological phenomena, including those of interest to education, is still the decontextualized individual. Hence, as Sarason (1981) so succinctly observed, "psychology at its core has been quintessentially a study of the individual organism unrelated to his history, structure, and unverbalized view of the social order" (p. ix).

Isolation and reduction: According to the first framing assumption, each psychological phenomenon or state of the individual's mind is to be conceptualized and studied as an entity onto itself. The underlying logic is, as Banaji and Crowder (1989) argue, "the more complex a phenomenon, the greater the need to study it under controlled conditions, and the less it ought to be studied in its natural complexity" (p. 1192). And this implies the separate study of discrete processes or states rather than the study of their combined, Gestalt-like functioning. How else would one be able to determine the

exact amount of variance in learning accounted for by, say, the experience of failure, or the amount of learning due to improved metacognitive mastery?

This phenomenon of reductionism has been described by Bartlett (1932; cited by Iran-Nejad, McKeachie, & Berliner, 1990) as simplification by isolation. A response "is cut off from the simultaneous functioning of other responses with which it is normally integrated" (p. 510), and thus it loses its true meaning. This practice is manifested, for example, in the study of intelligence divorced from the study of personality or volition, a practice badly criticized by Messick (1987). Messick, like Baron (1982) a while earlier, show how different the architecture of the cognitive engine is from the way it is operated in actuality by a willing, anxious, helpless, impulsive, or hesitant individual (recent exceptions pertaining to the study of intrapersonal composites can be found, for example, in Pintrich, 1994 ; Qian & Alvermann, 1995; Saklofske & Zeidner, 1995; and Weinstein, 1994).

Reductionism takes place when complex phenomena are broken down into their alleged independent causes or isolated constituent components, as if the former is identical to the latter. But it is not. As Searle (1992) argues, "Suppose we tried to say that pain is really "nothing but" the pattern of neuron firings. Well, if we tried such an ontological reduction, the essential features of the pain would be left out" (p. 117). And it is precisely that left-out residue of the conglomerate of states and processes that educational psychology ought to be concerned with. Closer to the field of educational psychology, Glaser and Bassok (1989), add that "It is good science to avoid confounded effects, but the eventual objective in these studies [on learning] is obviously not isolated phenomena... the process of transition or the various learning mechanisms may not operate in isolation" (p. 658).

I wish to propose that we study individuals as undivided units, configurations of cognitions, dispositions, interests, emotions, and such. Paraphrasing Sandra Scarr's (1985) words -- we ought to study the individual as a cloud of correlated events, processes, states, traits, and qualities.

The study of the decontextualized individual. The near exclusive focus on the individual has been very much an American way of framing life, success, and education (e.g., Sarason, 1981). The mind was figure, everything else was background noise. Interestingly, the common emphasis in the United States on the relatively decontextualized individual was never much shared by humanistic, transactional or socio-cultural psychologists. But then, these branches of psychology are less a product of American and more of European scholarship: Kurt Goldstein, Kurt Lewin, the Gestaltists – Wertheimer, Kofka, and Kohler, – Fritz Perl, Lev Vygotsky, and others have never seen the individual as an agent operating independently of context, culture and peers (Hamachek, 1987). Similarly, the recent (most welcome) tendency to examine the individual within a wider socio-cultural context, much influenced as it is by Vygotsky's writings, blurs the traditional boundaries between psychology and anthropology (Cole, 1991), a blurring which is perhaps appreciated but has not yet made its way into the mainstream empirical work of educational psychology.

The focus on the individual fit quite well with the post World-War II growing desire, particularly in the USA, to see psychology become a truly "hard" science, and this implied the development of the "Holy Trinity" of theory-research-quantification, which was seen to be best served by experimentation. Experimentation, by its very nature, meant that "individuals leave their social status, history, beliefs, and values behind as they enter the laboratory, or that random assignment vitiates the effects of these factors... [Thus] By stripping behavior of its social context, psychologists rule out the study of sociocultural and historical factors, and implicitly attribute causes to facts inside the individual" (Riger, 1992, p. 731).

Paradoxically enough, the cognitive revolution has further reinforced this trend by focusing on ever smaller intra-individual and mainly context-free units of analysis (Prilleltensky, 1989), becoming, as Eleanor Gibson (1994) has recently observed, increasingly more reductionistic. Bruner (1991) has lamented that the cognitive revolution has replaced "meaning" with "information" and "construction" with

"processing", the former requiring context while the latter does not. The field, according to him, has thus been technicalized and trivialized.

Indeed, the perception of the individual independent of any context needs to be questioned if, for example, we are to seriously consider the possibility that thinking and learning, are, in part at least, situated and distributed. Such a view should lead us to see them as embedded in, and reciprocally related to the contexts in which they occur. Seriously considering such a view by necessity precludes the a priori treatment of processes, skills, proclivities, emotions, traits, and mental events as decontextualized.

Seeing individuals "in context" may mean two somewhat different things. First, it means that the interpersonal, social, and cultural systems within which individuals function affect and are often reciprocally affected by individuals' actions and thoughts. Behaviors, cognitions, emotions, and such strongly interact with the surrounds within which they develop and function ( Bronfenbrenner, 1977; see also Bandura, 1989, and Mischell & Shoda, 1995). The second meaning of "in context" is more radical, implying that skills, strategies, and learning processes rather than being relatively neutral tools available for varied general application, are tightly welded to their immediate contexts of practice, that is – highly situated (e.g., Lave & Wegner, 1991).

It can be argued that because educational psychology has come to study individuals in real-life educational settings, studying common subject matter materials, and because constructivist, Vygotskian, and cultural ideas are now widely shared and discussed, that the field is less guilty of decontextualization in the Bronfenbrenner sense than in the Lave and Wegner sense. However, a crude examination of Journal of Educational Psychology issues (1992-1993) shows that out of 27 randomly selected empirical studies reported there, only 3 (11%) observed or measured anything beyond the aggregate of single individuals. The main concern of these three studies was social interactions in the classroom or home. But in the other 24 studies not a trace of social or cultural context could be found. In some of these, context would have been only an extraneous, superfluous, and irrelevant addition. But in at least half the studies, those dealing with styles of engagement with learning (Ainley, 1993), interest in mathematics (Mitchell,

1993), or the benefits of extracurricular activities (Marsh, 1992), context would have been of crucial importance. Context would be manifested via interpersonal tensions, consensual views of learning, social atmosphere, or peer-induced self efficacy. Nothing of the kind was even mentioned in these studies as if styles of engagement, interest in math, or benefits from extracurricular activities are totally independent of anything else which lies beyond the isolated individual. A random sample of 27 empirical studies published in that journal in 1994-1995 issues does not fare much better: Out of the 27 studies, only two (7.4%) deal with anything that goes beyond variables pertaining to the individual while at least 15 others (55%) would have benefited from going beyond the individual. For example, Karabenick and Sharma (1994) studied college students' perceptions of their teachers' support of students' questioning, and Graham, MacArthur and Schwartz (1995) studied effects of facilitating students' essay revising behavior. In neither study did the researchers include any measure that pertained to the classrooms' climate, shared views of learning or writing, or consensually held attitudes toward taking up class time for questioning or towards essay revising. Such variables would be expected to serve as important contexts that affect and are affected by the kind of students' perceptions and behaviors under study. It appears that the study of individuals in context, in the Bronfenbrenner sense, still has a long way to go.

In what concerns the "situated learning" meaning of studying "in context", we need not accept that <u>all</u> cognitions are situated, strongly affected by situational affordances, as Lave and Wegner (1991) contend; that intellectual activities <u>directly</u> interact with situations, rather than being mediated by abstract mental representations, as Winograd and Flores (1987) assume. Nor does one have to accept the idea that cognitions ought to be conceived of as distributed, as Pea (1993) holds. It is enough to accept the notion that <u>some</u> cognitions are <u>sometimes</u> situated, are under situational rather than representational guidance, and are socially or technologically distributed. Even if one accepts only the idea that some cognitions are socially distributed under some conditions (Perkins, 1993), or that distributed and "solo" cognitions mutually affect each other in an ongoing spiral of development (Salomon, 1993), then research that excludes

interpersonal, social, technological, and situational factors becomes badly one-sided and constrained. Thus, as Symour Sarason (1981, p. 20) has pointed out, learning is to an important extent a socially based process, and this should render suspect explanations that focus solely on the individual learner.

One reason for abandoning the perception of the decontextualized individual is the important variability in human behavior as a function of the situation in which people operate. As Riger has pointed out (1992), in the absence of context "Social explanations become residual, although sociocultural determinants may be just as robust and important as biological causes, if not more so" (p. 731). Context-less cognitions, idle proclivities, and personological tendencies receive undue credit; researchers commit the basic attribution error by disregarding contextual and situational influences, erroneously over attributing behaviors to intra-individual tendencies and abilities (Jones, 1979). And indeed, close examination of people's functioning in daily life (e.g., Saxe, 1991) clearly reveals the forcefulness of the situation, given its constraints and affordances, in affecting (and being affected by) cognitions and actual behaviors (See also, e.g., Ceci & Bronfenbrenner, 1991).

A second reason for adopting a more contextual view of the individual, as Cronbach (1982) points out, is that the observed effects of an educational treatment are not really just its own. "The circumstances surrounding the intervention are part of the cause" (p. 66). Cronbach goes as far as arguing that partialling these out by statistical or experimental means leads to the description (and often prescription) of a "counterfactual" treatment which "denatures" the true intervention. Such a "pure" intervention could hardly be designed, and if designed it would never really work because some of its more important contextual features have been left out.

In light of these arguments, I wish to suggest a change of focus -- from the study of the individual out of context to the study of individuals in context. Context and individual are to be seen as belonging to the same configuration of factors, mutually affecting each other.

## The Study of Composites

It is of course difficult to argue with the two framing assumptions discussed above. They have served and continue to serve psychology and educational psychology pretty well for some purposes and within certain paradigmatic structures. As long as thinking and learning were taken to be totally content- and context-free processes, and as long as one believed that to study (or design) anything, one has to single it out to determine its causal status and "net" contribution, research based on these assumptions did quite well. What with the study of the constituents of intelligence, the way test anxiety affects school learning, ways to cultivate metacognitions, gender differences on the SAT, relationships of phonological awareness to reading, and ways to change science misconceptions.

Indeed, one could not formulate theory-oriented hypotheses concerning causal relations and then rigorously test them without making the assumptions discussed above. Herein lies the strength of these assumptions but also their weakness, namely -- the hypotheses so formulated and tested serve theoretical frameworks very well, but their relevance to educational practice is questionable even though educational psychology has been taken out of the laboratory and into the schools. The reason for this is that the basic assumptions - that of the dissectable individual and that of the decontextualized individual - have not been altered (McGuire, 1973) regardless of whether transfer or the role of metacognitions in reading are studied in the laboratory or in the classroom. The individual is still decontextualized and her psyche -- dissected. Studying individuals in vivo instead of in vitro does not really make that much of a difference unless the in vivo study retains the composite nature of the reality in which individuals operate, which they experience and with which they interact (Lazarus, 1995).

If educational psychologists are willing to entertain the possibility that individuals as "clouds of correlated events" interact with the contexts within which they operate, then the complexity of the phenomena they will have to deal with increases significantly. For what students, teachers, parents and other caretakers experience and interact with during the educational process are composites of traits and volitions, social situations, and processes. Thus, it is not any more this or that discrete state, variable, microprocess

or chain of processes that is assumed to operate in a context-free mind, but rather the composite of states, processes, situational, and environmental factors that needs to be dealt with as the central unit of analysis.

Herein lies the crux of the argument: In any given situation, emotions, cognitions, preferences, dispositions, social, cultural, organizational, and physical factors operate in an orchestrated way, strongly affecting each other and giving meaning to each other, hence yielding composites which are neither identical to the sum of their components nor reducible to their components (Altman, 1988; Bandura, 1989). And it is the composites educational psychology should be primarily concerned with, not only with their discrete, isolated components. The atomic units of educational psychology are likely to be composite molecules. Thus, the complexity of the units, models, and composites educational psychologists construct, manipulate, measure, describe, and explain ought to match the level of complexity of the real-life phenomena under study. As argued by Cronbach (1982) who echoed the voices of ecologically-conscientious scholars such as Uri Bronfenbrenner and Michael Cole, "Units should be broad enough to encompass whatever community processes influence the phenomenon... Understanding an adolescent's experience or that of a recipient of plural social services seems to require a community-wide ecological perspective" (p. 74). E. Gibson (1994), rejecting what she called the plague of reductionism and reflecting on the current state of psychology, wrote in this respect -

> We must study behavior at its own level, looking for causes, predictions, and laws (may we be so lucky!) at that level. I quote a physicist who wrote recently, "The problem with these micro levels is that one is not able to describe the process as a whole, but only piece wise... These pieces are devoid of meaning. Because the meaning of behavior is to be found on the scale of the body of the agent, one has to pick a level of abstraction that allows one to express causal connections on that scale"(p. 71).

If educational psychology is to explain, guide, and develop educationally relevant interventions, its task, as distinguished from that of other branches of psychology, is to

study primarily persons within culturally and socially designed context composites, rather than reduce them to their constituent building blocks. For example, if classroom learning is the focus of attention, then its study calls for the development of concepts and models that fully reflect rather than oversimplify its complexity. Once this is done, the tension between theory-oriented and practice-oriented research is likely to disappear because the hypotheses to be tested and the models to be designed will be in greater agreement with the actual individual and social reality than the typical x-affects-y simple models. As a result "Theory-derived hypotheses will be similar to hypotheses selected for their relevance to social issues" (McGuire, 1973, p. 450).

Moreover, dealing with composites is necessary not only because it truely reflects the experiential nature of educational phenomena but also because the introduction of any change in educational practice requires a holistic approach. As Nevitt Sanford (1973) has pointed out a fair number of years ago:

> The above is the main argument for holism as the best road to knowledge; there is as strong an argument from the point of view of practice. If parts really are determined by the wholes to which they belong, and some one wishes to modify a part, then clearly his best course is to bring influence to bear upon the whole (p. 197).

This is precisely also what Symour Sarason (1991) so forcefully argues: You can predict failure of educational reforms as long as they focus "now on this part, now on that, this problem, that problem" (p. 43) while disregarding the way the whole structure hangs together. You either deal with composite wholes or you don't bother. On the other hand, the idea of dealing with composites on their true, complex level, seems to contradict Simon's (1982) recommendation to study and design complex system by decomposing them into their semi-independent components. But while educational psychology was and still is strong on decomposition, it is precisely the synthesis aspect of its yield that is so badly missing.

Once educational psychology raises its sights to the level of complex composites, one can see it becoming analogous to the scholarly study (as distinguished from the

engineering aspects) of architecture or aeronautical science (A. L. Brown, 1992). Consider, for example, architecture. Educational psychology resembles architecture in being a scholarly field which attempts, among other things, to design, not only to describe or explain. This is also one of the functions of aeronautics. Importantly, architecture is a good example of a field of study and design in which the basic "grain size" consists of composites: the apartment, the house, the cathedral, the shopping center, the neighborhood. The design of each such composite entails a variety of considerations emanating from other, more elementary, "basic" disciplinary fields of study, each of which dealing with one or another component of the composite: physics of materials, civil engineering, micro-climatology, soil sciences, electricity, art, sociology, environmental psychology, economics. The same pertains to aeronautics with its underlying sciences of engineering, navigation, aerodynamics, propulsion, energy, meteorology, and metallurgy. The unique feature of both architecture and aeronautics is their being orchestrations of elements that can neither be reduced to any one of the more elementary sciences, nor equated with any one of them.

As the sights of architecture and of aeronautics are by necessity set at the level of the orchestrated whole, not its building blocks, so ought the sights of educational psychology be set: the real-life learning environments, the family, the classroom, the street gang, the campus. These include the integration of motivational and cognitive, social and cultural, curricular and instructional, physical and affective, intentional and metacognitive elements. As in architecture, units of interest are conglomerates or composites, in which people act and learn, play and court each other. These composites need to be studied and designed as composites, not as dissected units reduced to their more basic ingredients.

What, then, about the study of more basic building blocks - motivations, emotions, cognitions, strategies, schemata, intelligence, measurement, and such -- the traditional staple of educational psychology? Where do they belong in the proposed scheme of things? The answer lies in the distinction between a system and its subsystems or, more figuratively, between a river and its (con)tributaries. Cognitions, metacognitions,

anxieties, abilities, motivations, strategies, and such are all subsystems that contribute to the composites that should concern educational psychology. These subsystems are crucial for educational psychology, but they relate to educational psychology much like the study of material strength relates to architecture, metallurgy to aeronautics, hematology to medicine, or history to archeology. Architecture cannot exist without the study of materials, archeology without the study of lineage, and medicine without biochemistry, but archeology or medicine cannot be equated with the study of lineage or biochemistry. There can be no educational psychology without the study of how meaning is obtained from difficult texts, how quadratic equations are solved, how graphs are understood, what mechanisms account for transfer, or how mental effort relates to school learning. But educational psychology cannot be reduced to these nor equated with them. It is based on these and orchestrates them into larger ecologically valid composites. It is in these composites that the uniqueness of educational psychology lies, and its potential grandeur is to be found.

One might of course argue that once educational psychology sets its sights as high as designing and studying complex entities like the whole classroom as it operates over time, one risks entering muddled waters of units too crude and gross for rigorous study. But this is really a matter of one's frame of reference. For example, for neuropsychologists the units handled by memory researchers are much too crude, much as the memory researchers perceive their friends from the attitude change lab as dealing with far too large and gross units. Bandura (1989) has observed in this respect that "Although psychological laws cannot violate what is known about the physiological system that subserves them, they need to be pursued in their own right. Were one to embark on the road to reductionism, psychology would be reduced to biology, biology to chemistry, and chemistry to physics, with the final stop in atomic particles" (p. 1182).

## The Question of Tools

The issue is not only one of epistemological perspective, paradigm or preferred approach. For these often emanate from the tools that are available and accepted as valid by the professional community. It is no secret that many of the prevailing psychological

conceptions, theories, and models are strongly influenced, some would say determined, by the tools of the trade (Gigerenzer, 1991). Theories of mind are discovered or developed as a consequence of the development of new tools for data analysis rather than as a consequence of new data. The conception of the mind as an intuitive statistician owes its development to that of statistics as a common tool, and Harold Kelley's attributional theory of the mind as ANOVA owes its development and popularity to that of the ANOVA as a statistical tool. This tool became far more popular than correlations, and hence, a theory of mind based on ANOVA was more widely adopted than Brunswick's lens-like conception of the mind which was based on Pearson correlations.

In the case of educational psychology, the tools employed in quantitative research are well suited for analytic, one-variable-at-a -time, additively interactive and easily measured or manipulated variables, not for the study of complex configurations and reciprocal processes. Not being familiar with tools that afford analyses of the latter kind means being blind to possibilities that are outside the reach of the common tools while continuously collecting and interpreting data only in light of these. Tools that allow the study of complex configurations do exist, of course, but they are rarely employed. Among the 27 educational psychology studies mentioned earlier, only one study (Goff & Ackerman, 1992) employed multidimensional scaling (although for peripheral reasons), and one study (Mitchell, 1993) employed LISREL. The point is that the range of quantitative tools that researchers in educational psychology tend to employ in their practice limits the kinds of models and theories they are willing to entertain; in the absence of familiarity with alternative tools, they simply do not look at things as patterns and systems.

Consider the composite "learning environment". What is it that one would want to know about a learning environment as a dynamic system and the way the individual behaves, develops, and functions within it? Learning environments, like all systems, have different qualities related to their respective structures. A learning environment dominated, for example, by fear or racial tensions is a different environment from that characterized by a desire for intentional, mindful learning. Such qualities of learning

environments can be operationalized by at least two parameters. First, learning environments have components with particular qualities, that is -- the contents and magnitude of the elements that constitute the system: The amount of mutual support, the specific meanings attributed to particular tasks, etc. Second, there is the way the elements hang together, the structure of the composite they jointly constitute. Think of a typical classroom. One could say something of interest about the quality of the social atmosphere, the perceived fairness of the grading strategy, or the nature of the mental models students most frequently employ when studying geometry. This is to say something, either quantitative or qualitative, about each of the system's discrete components, one at a time.

But one could also say something of interest about the way these elements hang together: What is central and what is peripheral in these classrooms? In what ways does their configuration differ from that of, say, less "didactic" classrooms? Is fear of grading central and social support peripheral, or is it the other way around? Along what dimensions do the different components of the learning environment align themselves and how do different kinds of environments differ from each other in this respect? Similarly, often the meanings that students give to a classroom task have less to do with what the teacher thinks she assigns the students, and far more with the socially negotiated agreements as to what a particular task "really" is: Is it a "problem" worth the expenditure of time and effort or is it an "assignment" to be gotten rid of? Are attitudes towards the study of science related to achievement, to entity perceptions of ability, or to the teacher's explanatory behavior? How central is the teacher?

Guttman's Small Space Analysis (SSA, a case of MDS; see e.g., Guttman, 1969) is a tool through which the simultaneous correlations among all variables measuring students' perceptions of a learning environment are expressed as Euclidean distances in a map-like manner. The higher the correlation between variables (points in that space), given all other correlations, the closer the distance between them. Such a map reveals the structure of a learning environment. It is a tool that affords the study of patterns, not just the traditional study of discrete variables, taken one at a time .

The example presented below pertains to experimental classes in which teams of students dealt quite autonomously with open-ended interdisciplinary authentic problems using technology extensively with an eye on reaching a serious and workable solution. The learning environment was operationalized as a set of perceived variables and was measured by student questionnaires; individuals' inclinations, abilities, perceptions, and achievements were measured separately by tests and questionnaires. The structure of 20 traditional, "didactic" classrooms was contrasted with that of 20 experimental, "constructivist", interdisciplinary classrooms. The differences of patterns were striking as revealed by the SSA maps presented in Figures 1 and 2, respectively.

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Insert Figure 1 and 2 about here

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As it can be seen, the regular, traditional classroom (Figure 1) has a clear structure. There is a "core" that can be interpreted as the "heart" of that environment. In that core one finds such individual variables as (pre-and post-project) achievements, perceived self efficacy, and personal importance of grades. There are also perceived classroom-oriented variables ("In our classroom..."; "The kids in our classroom think that...") such as quality of teaching, disciplinary strictness, value of science learning, extent of competitive climate, and learning climate. Around the core there is a scatter of variables of lesser centrality, nicely arranged in four wedge-like sections: Perception of teaching, cognitive variables, perceived social variables, and attitudes, a structure that suggests a clear differentiation among the four domains. The least significant variables in this pattern are such variables as perceived quality of team work, attitudes toward science, and perceived supportive social climate.

Comparison of this pattern with the one yielded by the more innovative experimental classrooms (Figure 2) reveals a number of important differences. The core of the pattern, that is - the tone-giving "heart" of the novel learning environment, consists of post-project (but not pre-project) learning achievements, accompanied by individuals' tendency to be mindful, by the class' willingness to expend effort, and by some of the group social variables: supportive social climate, quality of team work, and the group's

perceived self efficacy. Two of the previously separate "wedges" have merged, suggesting that cognitive and social factors now interact. Additionally, traditionally important variables of centrality in the more didactic classrooms, such as perceived of competitiveness of climate, perceived social tensions, personal importance of grades, and clarity of classroom procedures, have now moved out to the periphery. They do not seem to be of much significance in that kind of learning environment.

Guttman's SSA or any other MDS is only an example of a tool that offers the researcher new perspectives and ways of construing units of analysis. Such a tool also allows one to study individuals' data within the wider context, be it a classroom or housing project, on a par with that context. Obviously, such tools offer only a static view of how things hang together at one point in time and its use could be greatly enriched by combining it with qualitative observations, interviews, and records. Other tools (LISREL perhaps) might compliment an SSA and reveal more about the way things develop or change, or better yet, how things can be made to look differently.

## The Main Mission: Design

Most of what has been said so far could have been said about psychology in general and, indeed, is based in part on criticism from within that field. But there is also something unique that pertains solely to educational psychology, something that need not apply to social, developmental, general, or cognitive psychology. That "something" is the field's unique mission, its raison d'être of existence: Design.

One can identify three functions that current educational psychology tends to aspire to accomplish. These are as follows. (a) An explanatory function, the function of providing "explanatory concepts, concepts that will help people use their heads" (Cronbach, 1975, p. 126) to explain, predict, and better understand what happens, and the limits and conditions under which certain events and outcomes could or could not take place. A good example is the research that attempts to explain the role of specific knowledge and its cognitive role vis a vis that of general skills (e.g., Schneider, Korkel, & Weinert, 1989). A number of important implications follow from that kind of

explanatory framework, such as a better understanding of why programs designed to cultivate general skills often fail, and of what it would take to make them more successful.

(b) Educational psychology is characterized by its function as a guide of practice (Berliner, 1992), a function that follows quite nicely from the explanatory one, but not in a uni-directional fashion: It often is the case that guidance leads to the identification of new problems that require study and explanation. Thus, the explanatory and guidance functions are reciprocally related.

(c) Last, but foremost within the present framework, subsuming both scientific explanation and guidance of practice, is the function of educational development and design. This is where the educational psychologist engages in what Collins (in A. L. Brown, 1992) has called "design experiments", a multi-level and multi-focus activity in which psychological, curricular, instructional, interpersonal, activity, organizational, and often also physical aspects are jointly considered with the purpose of constructing a novel and viable learning environment. Herbert Simon has defined this kind of activity as the science of the artificial: It is an engagement "not with the necessary but with the contingent - not with how things are but with how they might be " (Simon, 1982, p. xi). It can be argued that it is in this latter capacity that educational psychology truly realizes its potential, contributing to science as well as advancing the field of education, reaching its true calling by uniquely combining the missions of explanation, guidance, and development.

Why design and why see it at the apex, the true calling, the fulfillment of educational psychology? The reason for raising the activity of design to the level of the field's main mission is that design, by its very nature, treats its field of reference -- education -- as a cultural, social, psychological, and organizational (and sometimes political) artifact rather than as a natural phenomenon. The qualities and course of development of natural phenomena are to be observed and respected; on the other hand, artifacts are to be shaped and improved for some purpose that transcends them. This is perhaps the difference

between, say, developmental psychology and early childhood education, and between cognitive psychology and instructional psychology.

As an artifact, education is something to be modified and improved, rather than to be studied from the side-lines. Accordingly, the field's ultimate mission is not just to discover how things are but how they could be. Resnick (1981) has already commented that the scholarly emphasis on the individual and on individual differences has made educational psychology unduly respect children's' (natural) course of development at the expense of trying to shape it. Design as the realization of potentials certainly goes the other way. In this capacity, limitations set by nature are to be studied as challenges to be overcome. The activity of design involves the breaking of new grounds by the integration of various considerations, principles, psychological hunches, theories, and hypotheses to create novel educational composites.

Design is also an important ingredient in understanding. Learners are supposed to attain better comprehension when designing, say, a multimedia presentation to explain the material to their peers (e.g., Carver, Lehrer, Connell, & Erickson, 1992). The same may apply to educational psychology researchers: Better comprehension of a complex learning phenomenon can be attained when one is designing a learning environment with emphasis on particular ingredients suggested by some theory. To quote Giambattista Vico of the early 18th Century, the one alleged to be the first constructivist, " 'to know' means to know how to make" (Von Glasersfeld, 1989, p. 123, cited by Duffy & Cunningham, in press). And to paraphrase Bronfenbrenner (1977), the one alleged to be the leader of ecological research: If you want to understand some complex composite - try to design it and make it work.

The works cited earlier as the exceptions that point to where educational psychology ought to go -- Brown and Campione's (in press) design of the community of learners, Scardamalia and Bereiter's (1993) CSILE Project, the Jasper, anchored instruction and other projects of the Vanderbilt group (Cognition and Technology Group at Vanderbilt, in Press), Slavin's Cooperative Elementary School (Stevens & Slavin, 1995), the SELA Project of technology intensive collaborative learning environments in Israel (Salomon

& Perkins, in press), and similar designs around the world -- are prime examples of what is being argued for here.

As reality often dictates, the design and study of novel and complex learning environments becomes a fruitful source of new ideas and hypotheses, thereby establishing an ongoing cycle of hypothesis testing through design and hypothesis generation through observations of the resultant learning environments. According to Gibbs (1979), this is what ecological validity is all about, and - I might add - this is also what ought to be the trademark of educational psychology. Psychology is brought to bear not just to explain things but to change them. And this, the design function, is what educational psychology should be all about.

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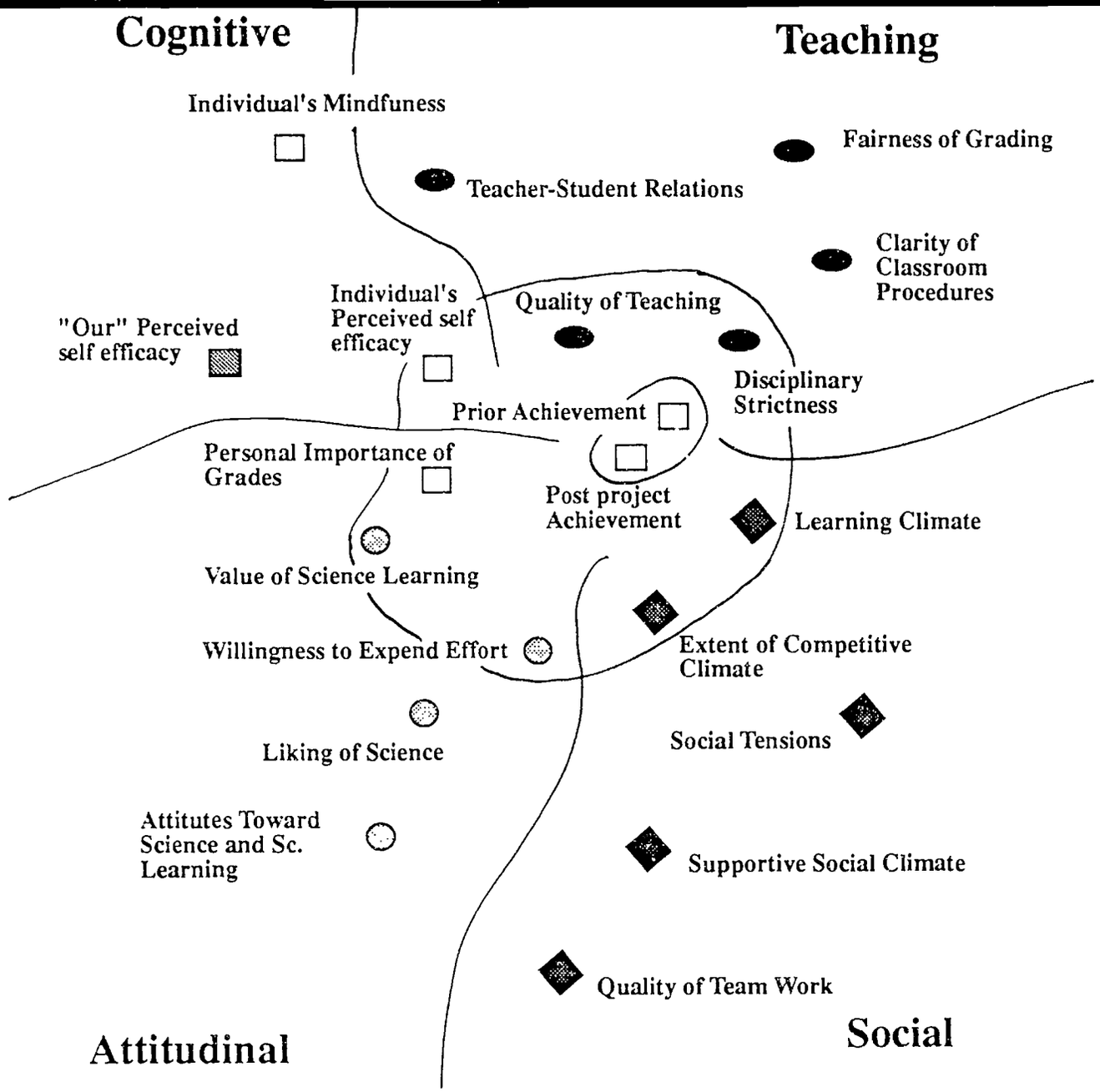
## Figure Captions

Figure 1: Small space Analysis of the post-project class and individual data for the regular (control) eighth grade science classes of 1992-3.

Figure 2: Small space Analysis of the post-project class and individual data for the experimental, technology-intensive, team-based, interdisciplinary problem solving eighth grade science classes of 1992-3.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Prior Achievement
Personal Importance of Grades
Post project Achievement
Learning Climate
Value of Science Learning
Willingness to Expend Effort
Extent of Competitive Climate
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Supportive Social Climate
Quality of Team Work
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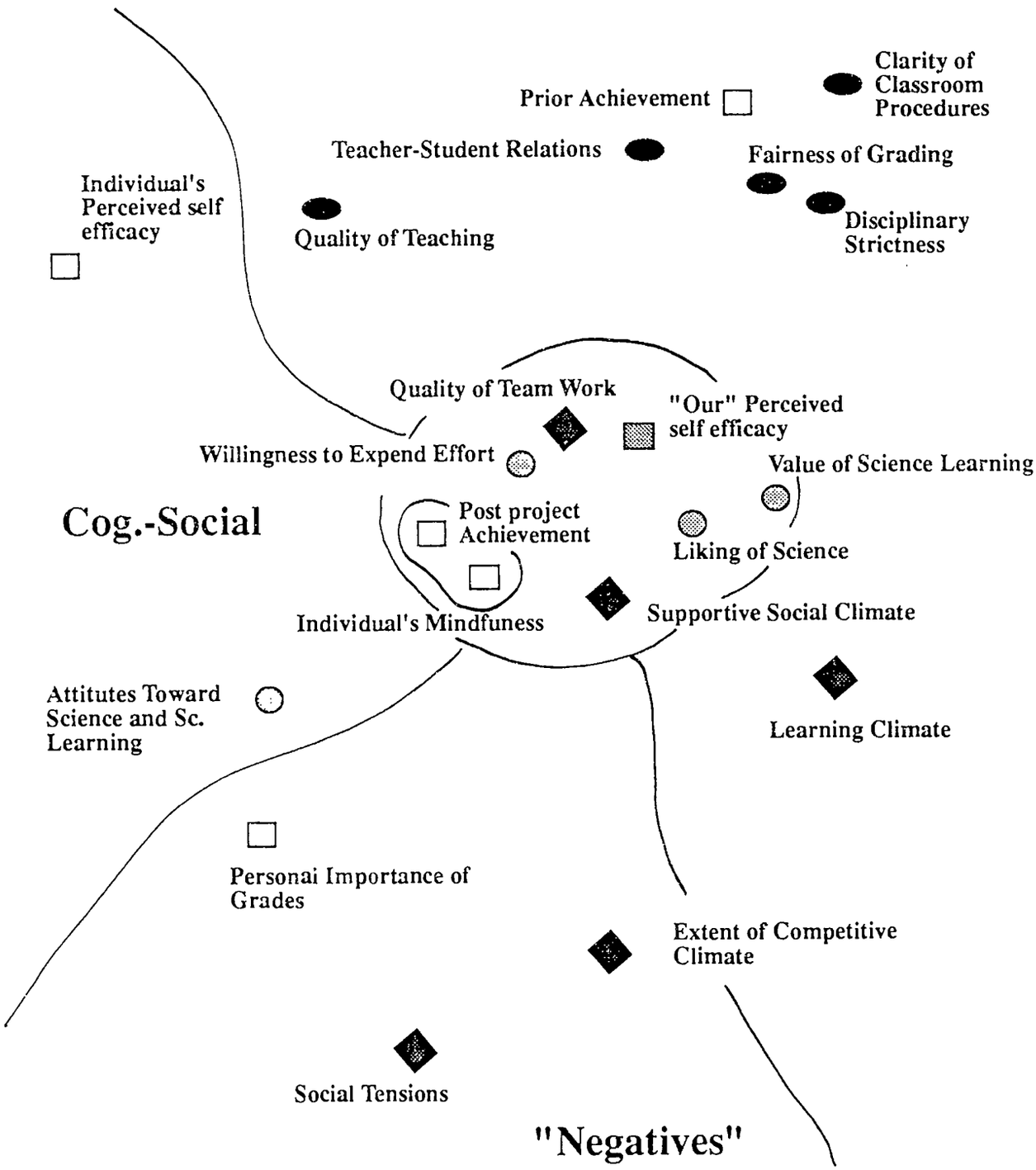
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